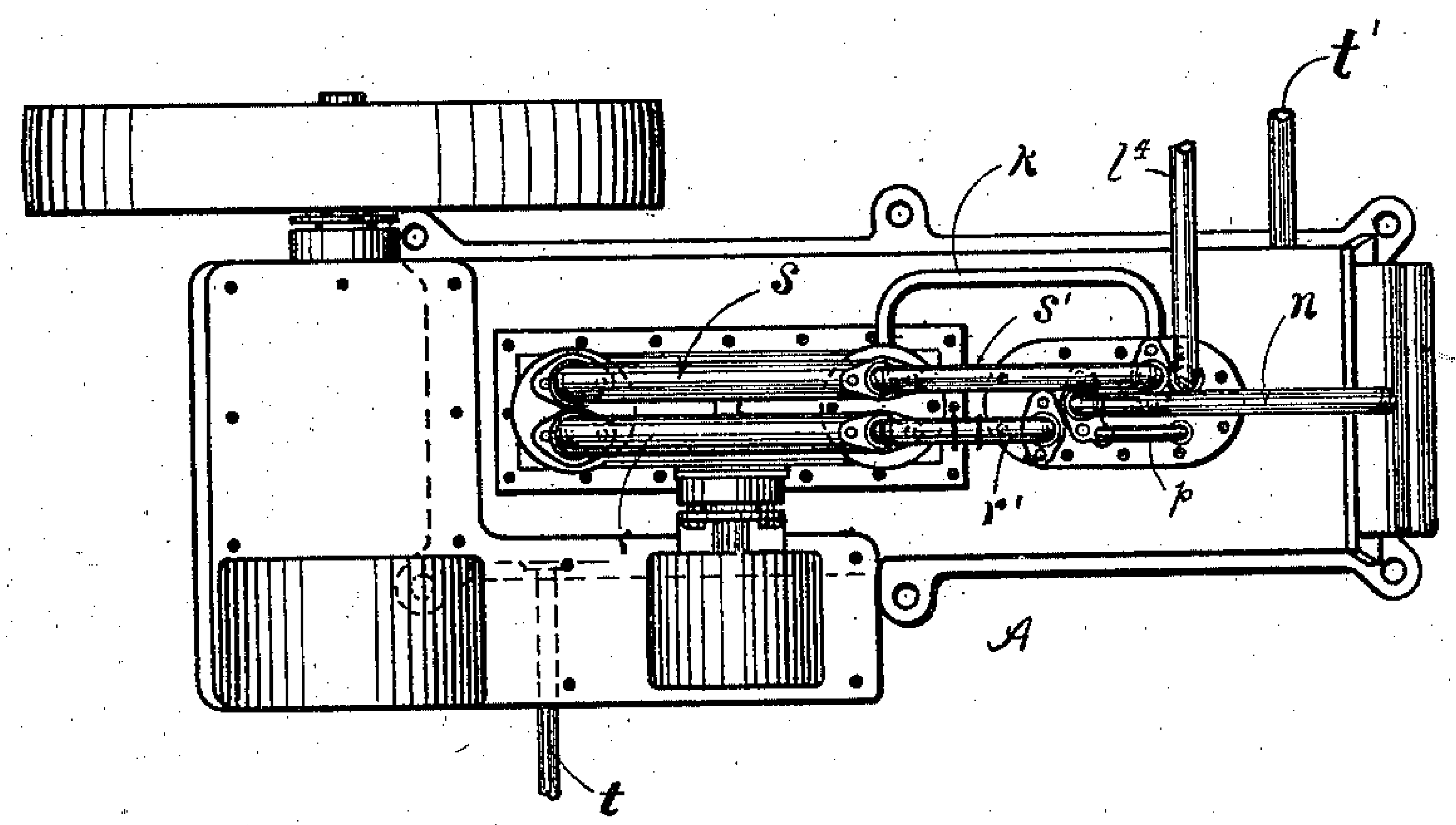
(No Model.) 2 Sheets—Sheet 1.

G. F. KNOX & E. L. SHARPNECK.

REFRIGERATING MACHINE.

No. 559,533. Patented May 5, 1896.

Fig. 2.



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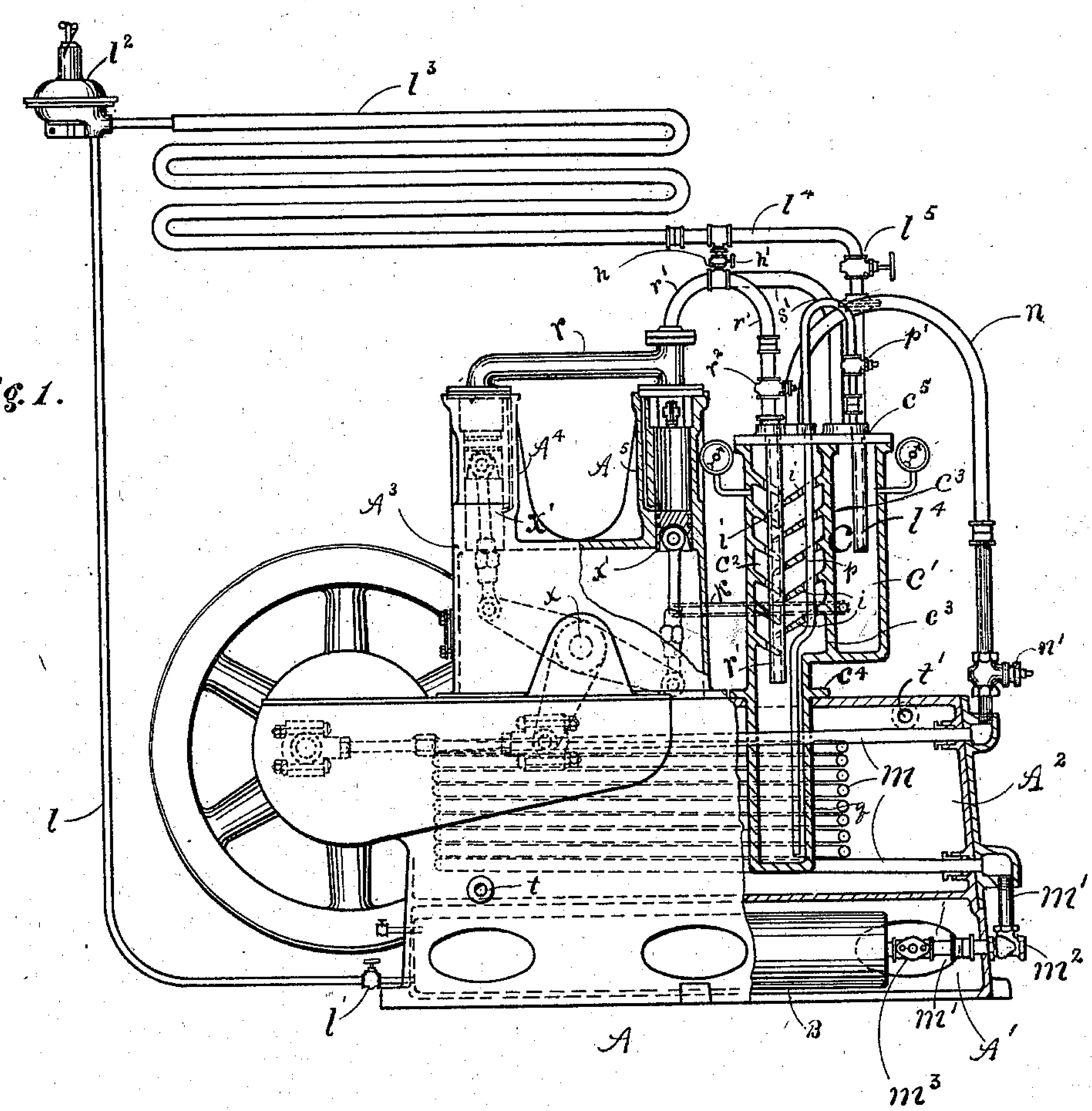

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(No Model.)

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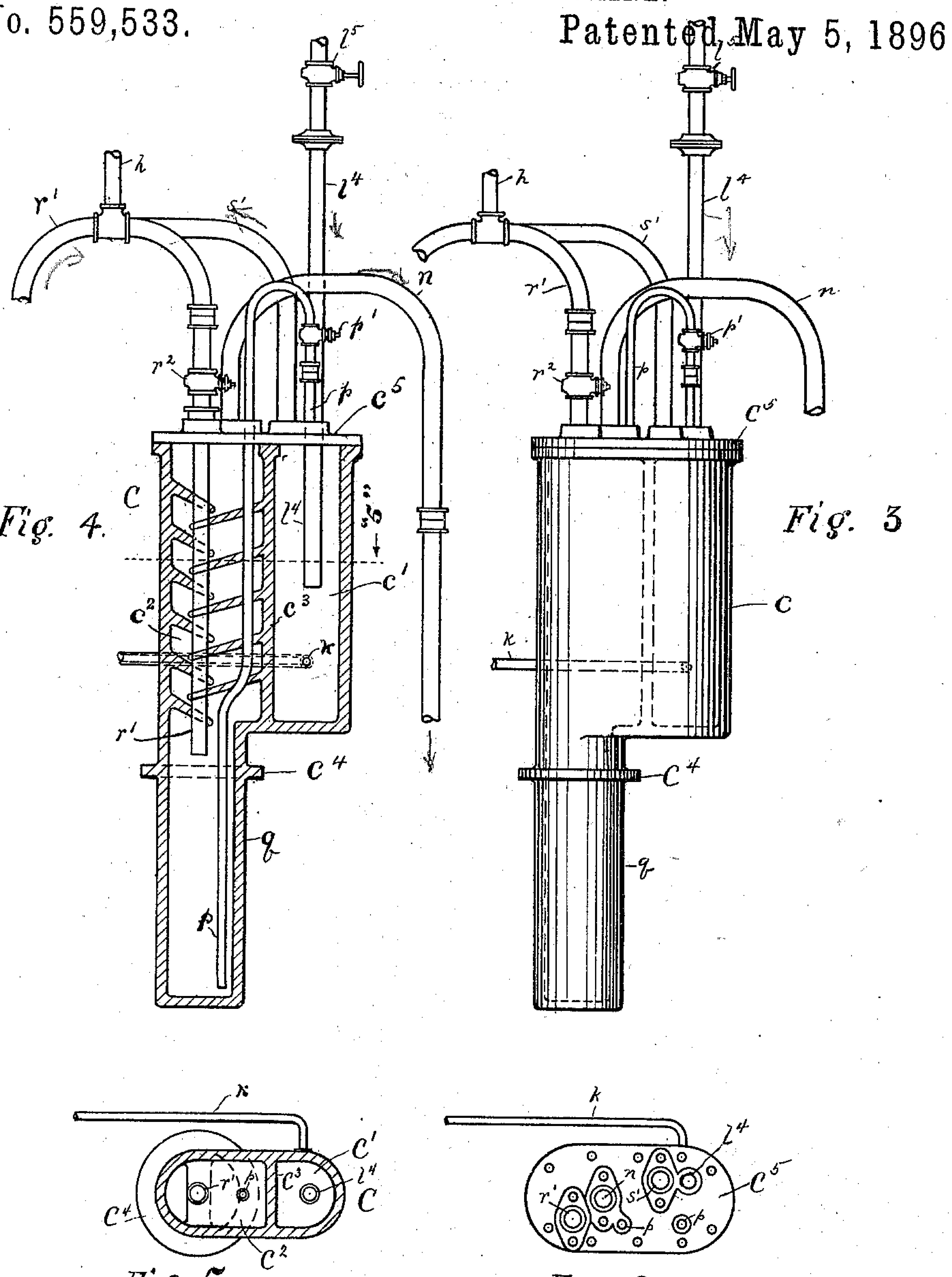

Fig. 4. Fig. 3

Fig. 5. Fig. 6.

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UNITED STATES PATENT OFFICE.

GEORGE F. KNOX AND ELIEL L. SHARPNECK, OF CHICAGO, ILLINOIS.

REFRIGERATING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 559,533, dated May 5, 1896.

Application filed August 29, 1895. Serial No. 560,850. (No model.)

To all whom it may concern:

Be it known that we, GEORGE F. KNOX and ELIEL L. SHARPNECK, citizens of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Refrigerating-Machines, of which the following is a specification.

Our invention relates to improvements in refrigerating-machines generally, though it goes more especially to improved mechanism for separating liquid ammonia and oil from the returned fluid before it goes to the condenser.

In the machine to which our invention is applied anhydrous ammonia is forced from a liquid receiver or storage vessel through a regulator and caused to expand in a chamber or refrigerating-coil, whence it is drawn by the action of a pump and compressed and condensed and discharged into the liquid receiver or storage vessel, the pressure from the pump in the liquid-receiver acting to force the fluid through the system, as described. It is usual in refrigerating-machines of this class to provide traps between the refrigerating conduit or coil and pump or compressor and between the compressor and condenser for the purpose of arresting any particles of liquid ammonia and lubricating-oil which might otherwise pass from the refrigerating-conduit to the compressor, and for arresting any oil which might otherwise flow to the condenser and be carried thence into the refrigerating-conduit. The traps are necessary in the locations mentioned for the reasons, first, that as it is desirable to have little or no clearance between the compressor-pistons and the ends of the cylinders in which they work oil or liquid ammonia entering the cylinders would tend to injure the compressor, and, second, any oil passing with the ammonia-gas into the refrigerating conduit or coil would tend to coat the inner surface thereof, and, being a non-conductor of heat, diminish the effectiveness of the apparatus. The trap between the refrigerating-conduit and compressor is called the "low-pressure" trap and is subject to the refrigerating influence of the gas, while the trap between the compressor and condenser is called the "high-pressure" trap and is subject to the heat of the compressed gas. As the traps have been hitherto constructed there has been danger in practice that the low-pressure trap would accumulate frost, which would clog the passages and stop the circulation, and that the high-pressure trap would heat and vaporize oil entering the same and so permit it to pass with the gas through the trap instead of being arrested.

Our object is to overcome the above difficulties by providing high and low pressure traps of improved construction and with means for communicating the temperature of one trap to the other. A simple construction of means for this purpose is a heat-conducting partition forming a dividing-wall between the traps through which each will have a temperature controlling or modifying influence upon the other, whereby the high-pressure trap will never become sufficiently heated to volatilize the oil, and the low-pressure trap will be prevented from becoming clogged by frost.

To the above ends our invention consists in the general construction of our improvements and also in details of construction and combinations of parts, all as hereinafter set forth and claimed.

In the drawings, Figure 1 is a view, partly in side elevation and partly in broken section, of a refrigerating-machine, showing our improved trap mechanism in place and also giving a diagrammatic illustration of the system; Fig. 2, a broken top plan view of the refrigerating-machine; Fig. 3, a side elevation of a casing inclosing what we term the "high-pressure" and "low-pressure" traps; Fig. 4, a vertical central section of the same, showing the internal construction and connecting-pipes; Fig. 5, a plan section taken on line 5 of Fig. 4 and viewed in the direction of the arrow, and Fig. 6 a top plan view of the trap-casing.

A is the refrigerating-machine, which is shown to contain a base-chamber A', in which is a liquid-ammonia receiver B, a condensing-chamber A^2, having an inlet-pipe t from a water-supply (not shown) and an outlet-pipe t', and a rock-shaft chamber A^3, provided with pump-cylinders A^4 A^5, in which the compressor-pistons work in a common manner.

The machine thus far described is of the same type as the machine set forth in our joint application for a patent upon a refrigerating-machine, Serial No. 544,340, filed April 3, 1895. The compressor-cylinders A^4 A^5 connect at their tops with a common induction pipe or chamber s and with a common eduction pipe or chamber r. In practice the chamber A^3 is filled with a lubricating-oil to a point above the rock-shaft x, which operates the compressor-pistons x'.

C is a casing provided with two chambers C' and C^2, separated from each other by a diaphragm C^3. The chamber C' forms what we term the "low-pressure" trap, and the chamber C^2 forms what we term the "high-pressure" trap. The construction of the shell is such that the high-pressure trap extends some distance below the base of the low-pressure trap and extends along its lower end portion q in the condensing-chamber A^2, and is thus surrounded by the water in said chamber. The casing C has a flange C^4, at which it rests upon the top of the chamber A^2 and seals the opening through which the part q extends.

Extending from the eduction-chamber r of the compressor is a pipe r', which passes downward through the top C^5 of the trap-shell C, preferably into the lower part q of the high-pressure trap C^2. A drain-pipe p extends from close to the bottom of the chamber C^2 upward in said chamber, out through the cover C^5, and back through the latter to the chamber C'. Above the cover C^5 and interposed in the pipe p is a valve p'. Extending from an opening in the cover C^5 at the chamber C^2 is a pipe n, which leads to a coil m in the condensing-chamber A^2. Interposed in the pipe n is a valve n'. The coil m connects at its opposite end, by means of a pipe m', with the liquid-receiver B, and interposed in the said pipe m' are valves m^2 m^3.

A pipe l, having an interposed valve l', leads from the the liquid-receiver B to a regulator l^2 at the expansion-coil or refrigerating-conduit l^3, and extending from the coil is a return-pipe l^4, which passes through the cover C^5 of the shell C downward some distance into the low-pressure trap C'. A pipe k connects at one end with the lower end portion of the chamber C', and at its opposite end with the chamber A^3, above the rock-shaft x. Extending from the top of the trap C' to the induction-chamber s is a pipe s'.

The operation is as follows: Gas from the refrigerating coil or conduit l^3 passes through the return-pipe l^4, enters the trap C', and is withdrawn through the inlet-pipe s', leading to the induction-chamber s. The pipe l^4, as before stated, extends downward some distance into the trap C', while the pipe s' extends merely through the cover C^5. The pipes l^4 s' form a return-conduit extending from the refrigerating coil or conduit to the induction pipe or chamber s and having the interposed low-pressure trap C', and the pipes r' n form an outlet-conduit for the compressor extending from the eduction pipe or chamber r to the condenser, and having the interposed high-pressure trap C^2. The gas entering the trap C' through the pipe l^4, being comparatively quiescent in said trap and having to rise to the pipe s', will become freed of the heavier liquid particles, whether ammonia or oil, and the said particles will settle into the lower part of the trap C'. The liquid ammonia caught in the trap C' will evaporate more or less quickly and be drawn out through the pipe s' to the induction-chamber s. As the oil accumulates in the trap C' and rises to the mouth of the pipe k it will flow through the latter to the rock-shaft chamber A^3, which, as before stated, contains lubricating-oil, to a point above the shaft x. The gas entering the induction-chamber s will thus be free from liquid of every nature and will not affect the action of the compressor. It may be stated here that were liquid of any form allowed to enter the compressor-cylinders with the gas, there would be danger of blowing out the cylinder-heads and of otherwise injuring the parts. In the working of the pistons x' they tend to discharge oil, in very small particles, of course, with the compressed gas, the oil working its way past the pistons at the cylinder-walls. As the gas is compressed it passes through the eduction-chamber r to the outlet-pipe r', and through the latter down to the lower part of the chamber C^2. From the said chamber it passes through the pipe n to the condensing-coil m, and thence by way of the pipe m' to the liquid-receiver B, the compressed gas being liquefied in the condenser in the usual manner. As the gas passes from the pipe r' into the chamber C^2, any particles of oil carried with it will tend to fall to the bottom of the trap while the gas rises to the pipe n, so that the gas entering the latter pipe will be freed of oil. As a further means of trapping the oil and of preventing its being carried upward in the chamber C^2 by the gas-current, we prefer to provide inclined and intermeshing deflector-plates i, which extend forward from the walls at opposite sides, as shown in the figures, and cause the gas to impact against their under surfaces and pursue a circuitous course between the pipe r' and the outlet to the pipe n. Any oil carried by the gas will be condensed upon the deflector-plates for the reason hereinafter explained, and as it accumulates it will run down to the base of the trap. Any particles of liquid ammonia caught in the trap C^2 will evaporate and rise and escape to the pipe n, while the oil will remain. When it is desired to clean out the trap C^2 by discharging therefrom the accumulated oil, this may be done by opening the valve p', whereby the high pressure in the trap C^2 will force the oil through the pipe p to the low-pressure trap C', whence it may flow through the pipe k to the rock-shaft chamber A^3, as before described.

Interposed in the pipe l^4 is a valve l^5, and interposed in the pipe r' is a valve r^2. These valves, during the working of the system as described, remain open. Extending between the pipe r' and the pipe l^4, in the manner shown, is a connecting-pipe or by-pass h, provided with a valve h', which is normally closed. When for purposes of repair or for other reasons it is desired to empty the traps C' C^2 of all ammonia-gas in order that the same may not be wasted, the valves l^5, r^2, and n' may be closed and the valves p' h' opened, when the compressor will suck the gas from the chamber C^2 to the chamber C', and thence through the inlet-pipe s' to the induction-chamber s and force it through the discharge-pipe r' and through the pipe h back into the coil l^3, after which the machine may be stopped until the repairs are made.

The gas entering from the refrigerating-coil to the low-pressure trap C' will be cold and will have the effect of chilling the diaphragm C^3. The gas entering the trap C^2, heated by the compression, will be preliminarily cooled by contact with the diapragm C^3 before passing through the pipe n to the condensing-coil m. The trap C^2 thus operates as a preliminary condenser.

Oil condenses at a higher temperature than anhydrous ammonia, and we take advantage of this fact in our construction by causing the chill effected in the trap C^2 by its contact with the trap C' to be sufficient only to produce a preliminary cooling of the ammonia-gas without liquefying it, but to liquefy and thus precipitate any oil carried by the gas. As the lower end of the trap C^2 is surrounded by water in the condensing-chamber, the oil falling in the base of the trap will be prevented from being again heated and vaporized by the heated gas entering from the pipe r'.

By providing the chamber A' as a part of the machine structure and having the liquid-receiver housed in the said chamber it simplifies the construction of the machine and causes it to take up less space than where the liquid-receiver is separated from the main structure.

We do not limit our improvements to use with refrigerating machines of the pattern herein illustrated nor to the specific construction shown and described, because the latter may be modified in the matter of details without departing from the spirit of our invention as defined by the claims.

What we claim as new, and desire to secure by Letters Patent, is—

1. In a refrigerating-machine, the combination with the compressor and its induction and eduction chambers, the condenser and the refrigerating-conduit, of a return-conduit extending from the refrigerating-conduit to the said induction-chamber, a trap interposed in said return-conduit, a discharge-conduit leading from said eduction-chamber to the condenser, a trap interposed in said discharge-conduit, and a heat-conducting wall separating the traps and operating as a means for communicating the temperature of one trap to the other thereby modifying the temperature of the other, substantially as and for the purpose set forth.

2. In a refrigerating-machine, the combination with the compressor and its induction and eduction chambers, the condenser and the refrigerating-conduit, of a casing having two chambers separated by a diaphragm and forming, respectively, a low-pressure trap and a high-pressure trap, a return-pipe leading from the refrigerating-conduit into the low-pressure trap, a pipe connecting the low-pressure trap with the said induction-chamber, a pipe leading from the high-pressure trap to the condenser, and a pipe leading from the eduction-chamber into the high-pressure trap, substantially as described.

3. In a refrigerating-machine, the combination with the shaft-chamber, the compressor and its induction and eduction chambers, the condenser and the refrigerating-conduit, of a return-conduit extending from the refrigerating-conduit to the said induction-chamber, a low-pressure trap interposed in said return-conduit, an outlet-conduit leading from the said eduction-chamber to the condenser, a high-pressure trap interposed in the said outlet-conduit, a heat-conducting wall separating the traps and operating as a means for communicating the temperature of one trap to the other thereby modifying the temperature of the other, a drainage-pipe provided with a valve and extending from the lower part of the high-pressure trap into the low-pressure trap, and a pipe extending from the lower part of the low-pressure trap to the shaft-chamber, substantially as and for the purpose set forth.

4. In a refrigerating-machine, the combination, with the shaft-chamber, the compressor and its induction and eduction chambers, the condenser and the refrigerating-conduit, of a casing having two chambers, separated by a diaphragm, and forming, respectively, a low-pressure trap and a high-pressure trap, a return-pipe leading from the refrigerating-conduit into the low-pressure trap, a pipe connecting the low-pressure trap with the said induction-chamber, a pipe leading from the high-pressure trap to the condenser, a pipe leading from the said eduction-chamber into the high-pressure trap, a pipe provided with a valve and extending from the lower part of the high-pressure trap to the low-pressure trap, and a pipe extending from the lower part of the low-pressure trap to the shaft-chamber, substantially as and for the purpose set forth.

5. In a refrigerating-machine, the combination, with the compressor and its induction and eduction chambers, the condensing-chamber and the refrigerating-conduit, of a casing having a chamber forming a low-pressure trap, and a chamber extending downward into the condensing-chamber and forming a high-pressure trap, a pipe extending from the refrigerating-conduit into the low-pressure

trap, a pipe leading from the upper portion of the low-pressure trap to the said induction-chamber, a pipe extending from the said eduction-chamber into the lower part of the high-pressure trap, and a pipe extending from the upper part of the high-pressure trap to the condensing-chamber, substantially as and for the purpose set forth.

6. In a refrigerating-machine, the combination with the compressor and its induction and eduction chambers, the condensing-chamber and the refrigerating-conduit, of a casing having a chamber forming a low-pressure trap and a chamber extending downward into the condensing-chamber and forming a high-pressure trap, a pipe extending from the refrigerating-conduit into the low-pressure trap, a pipe leading from the upper portion of the low-pressure trap to said induction-chamber, a pipe extending from the said eduction-chamber into the lower part of the high-pressure trap, deflectors in the high-pressure trap between the outlet from said pipe and the top of the trap, and a pipe extending from the upper portion of the high-pressure trap to the condensing-chamber, substantially as and for the purpose set forth.

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In presence of—
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J. H. LEE.